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Observations on the Properties commonly attributed by medical Writers to HUMAN MILK, on the Changes it undergoes in Digestion, and the Diseases supposed to originate from this Source in Infancy. By JOSEPH CLARKE, M.D. M.R.I.A.

SOME years ago, when I was appointed assistant to the Lying-in-Hospital of this city, an uncommon mortality prevailed among the infants born therein: Induced by this disagreeable necessity to peruse the works of many of the principal medical writers relating to infantile diseases, I was forcibly struck with the simplicity and uniformity of their pathology on the subject. For more than a century past it has been very generally supposed that the diseases of infants are all of the same genus, proceed from the same causes, and differ only in degrees*. Natural

Read Dec.
4, 1786.

* Vide Harris de Morbis acutis Infantum.

sensibility and delicacy of frame have been considered as the predisponent causes, and predominant acidity in the stomach and intestinal canal, as the occasion of almost all their complaints.

REASONING in this manner, *a priori*, we should expect in the cure of their diseases the practice to be simple and the event successful. In the adult state we know that there are few morbid causes less noxious to the human frame than acidity, and few more subject to the controul of medicine. A little experience and reflection should, in my opinion, be sufficient to convince an unprejudiced mind that the mortality of infants is much greater than could reasonably be expected, if the preceding theory, with regard to the exciting causes of their diseases, were well founded.

THE four following propositions will be found to contain the substance of the opinions of medical writers on this subject.

1st, THAT human milk is a chylous fluid, and readily affected by the kind of nourishment which nurses make use of.

2d, THAT it is coagulated in the stomach of infants, and that it is coagulable by acids, ardent spirits, and other known coagula.

3d, THAT it is *very prone* to run into an acefcent or acid state.

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4th, THAT from morbid deviations towards coagulation or acidity, by far the greater number of infantile diseases originate, and that a variety of saponaceous and absorbent remedies ought to be used to counteract these morbid causes.

THE first general proposition, viz. " that milk is a chylous fluid, and readily affected by food, &c." is of a nature which it is impossible to decide by experiment. Pure chyle is a fluid which has hitherto been collected in such small quantity, that its nature and properties are not yet well understood. It is said to coagulate on exposure to air or by stagnation. If so, I shall soon make it appear that in this particular at least chyle differs widely from human milk.

WHETHER the milk of a nurse be readily affected by the kind of food she eats or by medicines, is a question of which my own observation does not enable me to speak with decision. I shall therefore proceed to consider the second proposition, viz. " that milk is coagulated in the stomach of infants, and coagulable " by acids, ardent spirits, &c." This is a generally received maxim which admits of more prompt and decisive evidence than the former, and than which there is not perhaps one in all the medical folios more erroneous. In direct opposition to such sentiments, it may be safely asserted that woman's milk, in an healthy state, contains no coagulable mucilaginous or cheesy principle in its composition, or that it contains so little as not to admit of sensible proof. The late Dr. Rutty *, whose indefatigable

* Analysis of milk, appended to a pamphlet on sulphureous waters. A. D. 1762.

industry and accuracy in experiment is universally acknowledged, in treating of the comparative quantity of curd contained in different kinds of milk, states “ that woman’s milk, mixed with
 “ a quantity of runnet equal to what coagulated cow’s milk,
 “ gave of *curd* very little, even *not* a sixth part of what cow’s
 “ milk did.” Had he taken off the cream before he added the runnet, I am persuaded he would have stated the quantity of curd obtained as little or none. In fact his conclusion implies nearly what I have stated; he does not inform us what the quantity obtained was, but what it was not.

PROFESSOR Young’s conclusion, from a number of very satisfactory experiments, is, that human milk is not coagulated by runnets; nor do acids, whether mineral or vegetable, mixed with it in large quantity, produce any separation of curd from whey, whether the milk be tepid or raised to the boiling point.

DOCTOR Ferris, whose dissertation on milk gained the Harveian prize medal at Edinburgh in the year 1782, confirms Young’s experiments on this subject; and I have made a great number to the same purpose in endeavouring to detect the curd of human milk, but without success. I made use of all the different kinds of acids, ardent spirits, infusion of infants stomachs, &c. in various proportions and degrees of temperature, and I had perhaps a greater variety of milk from different women than any of the gentlemen already mentioned; and except in one or two instances never could perceive any thing like curd. In both the instances to which I allude there appeared, in consequence of spontaneous acescency, a small quantity of soft flakey
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matter floating in the serum. Ought not an appearance which does not occur above once in forty or fifty times to be considered as a morbid deviation from the healthy standard?

WE conclude that the milk of other animals contains curd, because it is readily detected by a watery infusion of the stomachs of ruminating, and of some non-ruminant animals, by acids, by ardent spirits, and by the juices of certain plants, and because by the admixture of these we are enabled to collect a quantity of viscid matter, which when exposed to pressure is well known by the name of cheese. But every part of this evidence is deficient in regard to human milk. Whence then is the conclusion drawn? It is a conclusion depending on one single circumstance, viz. the appearance of the fluids vomited by infants after sucking. In describing the diseases of young children, authors have been in the habit of enumerating "vomiting of curdled milk," as a frequent symptom, and hence seems to have arisen the general opinion. But surely such descriptions would have been more accurate had they been thus stated, "infants often throw up quantities of a soft viscid matter resembling the coagula of milk, and this is frequently mixed with a good deal of turbid whey-like fluid."

It appears to me surprising that Dr. Young was not able to solve this difficulty, after he was fully convinced that no artificial means were sufficient to separate a curd from woman's milk; "yet," says he, "this separation takes place spontaneously, especially if it be placed in a situation equal to 96° of Fahrenheit's thermometer, and it is daily observed in the milk which
" infants

“ infants vomit.” It deserves to be here remarked that these observations are stated as matter of opinion, and not the result of any experiment. I determined however to try them as far as possible by this test. I took equal quantities of three different kinds of milk, put them into bottles slightly corked, and these bottles into water, the temperature of which was kept up by a spirit of wine lamp as near to 96° of Farenheit as possible. But after frequently examining each bottle, during the course of the experiment, at the expiration of several hours there was not the smallest tendency towards coagulation to be perceived in any of them. As usual, the cream was thrown to the surface thick and adhesive, and entirely separated from the fluid underneath, which had somewhat of a grey wheyish appearance.

As the matter vomited by infants is sometimes more adhesive than we might suppose cream to be, I suspected that the curd might be so entangled with the cream as to be with difficulty separated from it; I therefore collected a quantity of rich cream from a large quantity of milk of different women, and repeated the former experiment with precisely the same event. Towards the conclusion I added acids, both mineral and vegetable, but without producing any thing like curd. Indeed I had little doubt, before any experiment was attempted on this subject, that Dr. Young was mistaken in the idea of milk separating into curds and whey in a certain degree of temperature; for was this fact we should every day meet with stagnant milk in the mammæ, where it is exposed to the heat of the human body,
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thus separating and producing very troublesome obstructions; but this we know does not take place.

THAT the powers of an infant's stomach may produce effects on milk which no other power can, is extremely possible; but that it cannot create any new principle, or cause a separation of a principle which it does not contain, can hardly be doubted. Repeated experiments have shewn that the stomachs of ruminant animals for some time after death possess some of their most remarkable powers while living, and particularly that of coagulating milk; there is every reason to expect the same of the human stomach, and in several trials we have not been disappointed.

I took out the stomach of a foetus deprived of life in the birth by lessening the bulk of its head. The gastric fluids in such a stomach could neither be altered by disease nor the admixture of food. I infused it in a small quantity of hot water, so as to make what might be considered a strong infusion. To equal quantities of cows and human milk I added a tea-spoonful of the above infusion; in a short time the cows milk was firmly coagulated, the human not in the least changed. At the end of the first hour I added a second tea-spoonful of runnet to the human milk, and soon after a third, without producing the smallest perceptible tendency to coagulation.

UPON the whole then I am persuaded it will be found that human milk, in an healthy state, contains little or no curd, and

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that the general opinion of its nature and properties is founded on fallacious analogy and superficial observations made on the matter vomited by infants.

WE may presume that the cream of woman's milk, by its inferior specific gravity, will swim on the surface of the contents of the stomach, and being of an oily nature, that it will be of more difficult digestion than any other constituent part of milk. When an infant sucks very plentifully then, so as to over distend the stomach, or labours under any weakness in the powers of digestion, it cannot appear unreasonable to suppose that the cream shall be rejected first by vomiting. Analogous to this we know that adults affected with dyspepsia often bring up greasy fluids from the stomach by eructation, and this especially after eating fat meat. We have in some instances known this to blaze when thrown into a fire, like spirits of wine or oil.

THAT viscid cream has given rise to the opinion of curd in the milk vomited by infants, is still farther confirmed by the following fact: Having constantly observed that the milk of women, for some days after delivery, threw up a copious *yellow* cream, it occurred to me that, if my ideas on this subject were just, what is commonly called curds, as vomited by infants, ought to be of a yellow colour for the first few days after birth. Accordingly I put this question to all our experienced nurse-tenders in the Lying-in-Hospital: "Is there any difference
 " of colour in the curds vomited by infants of four or five
 " days old and by those of a fortnight or three weeks?" It happened that two or three of them were sitting together when I
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first thought of proposing this question. They answered unanimously, and without hesitation, “ Surely, Sir, there is, until the “ beesting milk is over the curds are *yellow*, and afterwards they “ become *white*.”

I SHALL now hasten to consider the third general proposition, viz. “ That woman’s milk is prone to run into an acedent or “ acid state.” Acescency and acidity are relative terms, and can be applied with propriety only in consequence of accurate comparison. Whoever takes the trouble of attentively comparing human milk with that of the ruminant animals will soon find it to be much less prone to run into the acedent or acid process. I have very often exposed equal quantities of human and cows milk in degrees of temperature, varying from the common summer heat, or 65 to 100, and I have constantly found that cows milk acquires a greater degree of acidity in thirty-six hours than the human did in many days; cows milk becomes offensively putrid in four or five days, a change which healthy human milk, exposed in the same manner, will not undergo in many weeks, nay sometimes in many months. I once kept a few ounces of a nurse’s milk, delivered about six or seven days, for more than two years in a bottle moderately corked. It stood on my chimney piece, and was frequently opened to be examined. At the end of this period it shewed evident marks of moderate acidity, whether examined by the taste, smell, or paper stained by vegetable blues or purples; the latter it changed to a florid red colour, whereas cows milk kept a few days changed the colour of the same paper to a green, thereby clearly shewing its putrescent tendency.

DOCTOR YOUNG observes in general that the milk of the whole class of non-ruminant animals is less acedent than that of the ruminant.

I HAVE been able to find but one other author whose observations at all coincide with mine, and for his authority I am indebted to the industry of the late Baron Haller. This author is a M. Navier. His words are “ *Lac femininum nullum prodit acoris signum. Post quadraginta et tres integros dies non magis acet quam lac vaccæ recens.*” Haller’s observation on this passage is “ *Ea vis est victus animalis;*” and thus he seems to think this singularity accounted for. But many of my experiments were made on the milk of women rigidly confined to gruel, bread and whey, and therefore the phenomenon observed by Navier was probably not the effect of animal diet. Perhaps another instance could not be adduced of an animal fluid resisting so powerfully the changes produced on most bodies by fermentation. Whether it is to be attributed to the saccharine nature of milk taking up a length of time in going through a vinous fermentation previous to the acid stage, or whether this saccharine principle, so abundant in human milk, be of an antiseptic nature, and thus prevents the other principles from running into the putrid stage of fermentation, I shall not pretend to determine. Of the fact I have no doubt, however it may be explained. If we find milk out of the body so very slow in running into an acedent state, does it not afford strong presumptive evidence that the milk of nurses cannot be so very prone to run into acidity in the stomachs of infants as authors endeavour to persuade us?

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Our suspicions on this head will be strongly increased if, on reviewing the signs supposed to indicate acid acrimony, they be found deficient and inconclusive. Curdled milk and green four-smelling fæces are the marks which have been generally thought to characterise predominant acidity. Enough, I hope, has been already said to expose the mistaken notions derived from the first appearance, viz. "curdled milk." Against the second, we are enabled to speak on the authority of Sydenham: In his letter to Dr. Cole, on hysteria, he asserts, that the green herbaceous coloured stuff thrown up in hysteric cholic is no proof of acrid humours being the cause of the disease; for, says he, healthy people when sea-sick evacuate similar matter. And further, let us take his own words, "*Annon et infantes in paroxysmis convulsivis, in quibus spirituum animalium maxime res agitur, tam per superiora quam per inferiora materiam ejusdem plane coloris ejiciunt? Emeticis etiam et catharticis frequentius propinatis uberior materiæ viridis nascitur seges. Et profecto.*" Says he elsewhere, "*Ita lubrica est et evanida colorum speculatio ut nihil certi ex illis de corporum in quibus adparent natura queat apprehendi.*"

THE opinion of green fæces in infancy being occasioned by predominant acidity, rests very much on a supposition that bile and acid mixed produce a green compound. Sylvius says, "*Non dubitamus asseverare, ortum habere notatam alvi dejectionem viridescentem à bile ab acido acri corruptâ, et in virorem deductâ; quales mutationes colorum, haud ignotæ sunt tinctoribus.*"

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HARRIS, who expanded the doctrine of Sylerus, and who from his high rank and supposed success in practice brought this doctrine into great fashion in England, says, “ *Quod viridis* “ *fæcum color acido bili admixto se prorsus debeat, observationi plane* “ *sensibili illorum, qui experiri amant colorum in viridem mutationes* “ *aceto et spiritibus acidis perficiendas, evidentissimè apparebit.*” Having already found many assertions equally positive to be erroneous, I determined to doubt every thing advanced on the subject; I therefore procured some bile from the gall bladder of a fœtus which was deprived of life in the birth; it was of a deep yellow colour and thick consistence. After diluting some of this bile with milk, I gradually dropped into it some strong vinegar without being able to perceive the least change of colour; whereas on adding nitrous acid, even in very small quantity, to a portion of the same diluted bile, it immediately changed it to a deep *green*. This experiment I repeated in presence of some of the pupils of the Lying-in-Hospital with precisely the same event. I should not venture to state two experiments as proof in any doubtful case, did I not find them confirmed by Dr. Maclurg, the latest and most accurate experimenter on this subject. In the first eight experiments* on human cystic bile, this author endeavours to ascertain the effects of mineral acids on bile; these he found, when applied strong, united with it and dissolved it in a short time, with some variations of the phænomena, producing a fine *green* colour.

* See an analysis of Dr. Maclurg's experimental enquiry on bile in the Edinburgh Medical Commentaries. Vol. 1st, p. 150.

IN the ninth and tenth experiments, this author gives an account of the effects of vegetable acid on bile: He found that vinegar and lemon juice instantly coagulated it, at the same time changing its colour to *yellow*.

FROM these facts then it appears that the assertions of Sylerus, Harris and others, in regard to the mixture of bile and acids, are but partially true. It is to be remembered that the mineral acids only form a green compound with bile. Nothing equivalent to any of the mineral acids can with probability be supposed to be generated in the intestines of an infant, and therefore recourse must be had to some other mode of accounting for their green fœces. Why should sour milk, granting its existence, give rise to them in infants and not in adults? Have butter-milk, summer-fruits of the most acedcent kind, lemon or orange juice, always this effect in adults by their admixture with bile? This is a question which cannot, I believe, be answered in the affirmative.

UPON the whole, I hope it will appear probable to the generality of readers, that predominant acidity in the primæ viæ is by no means so general as to be considered the *only* or even *principal* source of infantile diseases; that such a morbid cause may now and then occur in infancy as in adult age, from weakness of stomach, costiveness or improper food, can admit of no doubt. Fœces changing paper stained by vegetable blues or purples to a red colour, afford satisfactory evidence of the fact; but any conclusions drawn from their colour or smell must from the nature of things be liable to great uncertainty. Those writers
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who have laid the greatest stress on such appearances in infancy, do not pretend to apply the information to be derived from them to the treatment of the diseases of adults.

THE fourth general proposition, viz. “ That from morbid “ deviations towards coagulation or acidity in the milk of nurses, “ the greater number of infantile diseases originate, &c.” I think extremely doubtful, and for the following reasons :

WOMAN’S milk, in an healthy state, contains little or no coagulable matter or curd.

It shews less tendency out of the body to become acedent than many other kinds of milk.

THE appearances which have been generally supposed to characterize its acidity do not afford satisfactory evidence of the existence of such a morbid cause.

BUT granting such acidity to prevail, we are in possession of many harmless medicines (called absorbents) capable of neutralizing acids, and thus forming innocent compounds. We have every advantage to be wished in exhibiting such remedies. They have no taste; they may be safely given in large quantities; they may be freely used both by the nurse and infant to prevent as well as to cure such disease, and notwithstanding we have every day the mortification to see infants languish and die under such courses.

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THE young of all the ruminant animals, fed on milk of a much more acescent nature, suffer no inconvenience from this source.

HISTORY furnishes examples of whole nations using four curdled milk as part of their daily food; we cannot suppose that such a practice would be continued were it often followed by pernicious effects.

REGISTERS of births and deaths prove that in one situation a half of the whole human race born dies under the age of two or three years; whereas in another situation one half shall live to the age of thirty-five or forty years and upwards.

FROM the same authority it appears, that in every situation and country a much greater proportion of the male sex dies than of the female, and particularly in early infancy. In the Lying-in-hospital of this city, during a period of about twenty-seven years, of three thousand one hundred and ten infants dead under the age of fourteen days, one thousand seven hundred and seventy-two were of the male sex, one thousand three hundred and thirty-eight of the female; the deaths of the former exceeding that of the latter nearly by one third.

SUCH are my reasons for doubting of the prevailing opinions concerning human milk and the origin of infantile diseases. Neither the affectation of singularity, nor the desire of substituting any new theory in place of that commonly received, have had any share in prompting me to state these doubts to this Academy.

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I have been actuated to do so solely by the hope of exciting others to enquire after truth. I do not expect that my arguments will afford conviction to any firm believer of the established opinions on this subject; the authority of one man is rarely sufficient to overturn or even invalidate an opinion generally and long received, especially when the nature of the subject does not admit of demonstrative proof. The united labours of Willis, Baglivi, Hoffman and Cullen, were necessary to reform the humoral pathology of their predecessors in regard to the diseases of adults; the hypothesis of almost all diseases being produced by morbid matter and various kinds of acrimony abounding in the human fluids ceases to be believed, nay is generally denied.

I CANNOT conclude without expressing a hope that a well-directed attention from physicians of the present or succeeding age may strike out a more rational and successful system of practice than the present in regard to the diseases of infancy.